ABSTRACT OF THE DISCLOSURE

In a method for treating a semiconductor substrate, a single substrate is positioned in a single-substrate process chamber and subjected to wet etching, cleaning and/or drying steps. The single substrate may be exposed to etch or clean chemistry in the single-substrate processing chamber as turbulence is induced in the etch or clean chemistry to thin the boundary layer of fluid attached to the substrate. Megasonic energy and/or disturbances in the chamber surfaces may provide the turbulence for boundary layer thinning. According to another aspect of a method according to the present invention, megasonic energy may be directed into a region within the single-substrate process chamber to create a zone of boundary layer thinning across the substrate surface, and a single substrate may be translated through the zone during a rinsing or cleaning process within the chamber to optimize cleaning/rinsing performance within the zone.